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ABSTRACT

This research project investigated the effects of computer-assisted cooperative learning in mathematics instruction within integrated classrooms for 118 third-graders (25 with learning disabilities) and 92 fourth-graders (16 with learning disabilities). Students were grouped into cooperative learning, whole-class, or individual learning situations to learn math with the help of computer technology in class. Three computer software packages were used for students to learn math concepts, including computation, application, and problem solving skills. All the students took pre- and post-math achievement tests and participated in a learning attitude survey. Results showed that the cooperative learning group's scores on math achievement were statistically higher than those of the whole-class learning group. Also, the results of the attitude survey showed that the cooperative learning group had higher scores on preference of the learning subject, effort, accomplishment, and self-confidence than those in the whole-class learning group. In addition, a social acceptance scale administered to the general education students indicated that in the cooperative learning group the students' willingness to engage in social contact with students with disabilities was higher and their avoidance of social contact with students with disabilities was lower than the other learning groups. Relevant evaluation materials are attached. (Contains 33 references.) (Author/CR)

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ED 412 696

The Effects of Computer-assisted Cooperative Learning in Mathematics in Integrated Classrooms for Students with and without Disabilities

Final Report

by

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U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
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Abstract

This research project investigated the effects of computer-assisted cooperative learning in mathematics instruction within integrated classrooms for students with and without disabilities.

A total of 118, 3rd grade elementary students, among whom 25 have learning disabilities, and 92, 4th graders, among whom 16 have learning disabilities, participated in the research. These students were grouped into cooperative learning, whole-class or individual learning situation to learn math with the help of computer technology in class. Twelve general education teachers were randomly assigned either to cooperative learning, whole-class or individual learning group to instruct math following the curriculum. Five special education teachers with their participating students were integrated within the general education classes. Three commercial computer software packages were used for students to learn math concepts, computation, application and problem solving skills. All the students had pre, post math achievement test and learning attitude survey. Results showed that student scores on math achievement of the cooperative learning group were statistically higher than those of the whole-class learning group. Meanwhile, the results of an attitude survey showed that students in the cooperative learning group had higher scores on preference of the learning subject, effort, accomplishment and self-confidence than those in the whole-class learning group.

In addition, a social acceptance scale administered to all the participating general education students. The results indicated that in the cooperative learning group the students' willingness to engage in social contact with students with disabilities was higher, and their avoidance of social contact with students with disabilities was lower than those in the whole-class and individual learning groups respectively. Also, interviews of special education students showed that students with learning disabilities were likely to be included in the general education class only when they could be accepted and their academic and social needs could be met. However, there were no significant differences between the groups on the outcome measures of math achievement and learning attitudes among the fourth graders.

INTRODUCTION

Placing students with disabilities in regular classrooms is the beginning of an opportunity to influence their lives. This is regarded as mainstreaming, a practice, that has been implemented in many American schools during the past decade (Johnson & Johnson, 1986). The purpose of mainstreaming is to facilitate positive relationships and attitudes among students with and without disabilities.

Since the 1980s, inclusive education, i.e. inclusion of special education students into regular classrooms with their age appropriate peers, as a means of integrating students with disabilities, has been advocated by educators and parents (Haring & McCormick, 1990). As students with disabilities are included in regular classrooms, teachers are confronting the challenge of developing adaptive instructional strategies to meet the unique needs of students with disabilities. In such an integrated setting, how do teachers take responsibility to help foster positive exchanges among students with disabilities and general education students? How do they teach a class of students with diverse level of performance and ability? Research has indicated that a key factor in answering these questions is to find how teachers structure the integration among all students as they work toward their academic attainment and interpersonal goals in the classroom (Johnson & Johnson, 1989). Inclusion of students with disabilities must be linked with appropriate modifications in teaching techniques and strategies away from traditional

whole-class instruction to meet the needs of diversity of students (Putnam, 1993). Cooperative learning is one way to enable students with varying needs to work together to accomplish shared learning goals. Research evidence has supported cooperative learning as an effective strategy to provide learning opportunities for students with and without disabilities to integrate in general education classes, and to improve positive social interactions as well (Johnson, 1983, Slavin, 1990). However, questions remain about the effects of cooperative learning on academic achievement of integrated students with disabilities (Lloyd, Crowley, Kohler & Strain, 1988, Tateyama-Sniezek, 1990). Further research focusing on the academic achievement of students with and without disabilities in cooperative learning has been recommended. As computer-assisted instruction (CAI) is implemented in general education class activities, and more computers are used in schools, Light and Blaye (1990) found that when cooperative learning combined with computer-assisted instruction better learning outcomes were shown than individual learning. However, little research has been conducted to examine the use of cooperative learning in a computer-assisted environment in inclusive educational settings for students with and without disabilities, and to investigate whether the cooperative learning model is applicable to math curriculum with computer-assisted learning activities to facilitate student academic achievement and positive learning attitudes. The present research employed a cooperative learning

model in a computer-assisted environment for math instruction in inclusive classrooms. The objective of the study is to analyze the effectiveness of the cooperative learning strategy to improve math achievement of students with and without disabilities in integrated classrooms.

IMPORTANCE

As American schools move toward the goal of providing education for children with and without disabilities in inclusive classrooms, teachers are facing the challenge of developing appropriate instructional approaches to meet the needs of diverse students in the heterogeneous class. It is clear that physically including students with disabilities in the classroom with general education peers will not ensure the accomplishment of their academic and social goals. In an inclusive learning environment all children need to benefit from and be enriched by having an opportunity to learn from one and another (Sapon-Shevin, 1992; Stainback, Stainback, & Jackson, 1992). Cooperative learning has been advocated as a means to provide the opportunity for promoting integration of students with and without disabilities in inclusive classrooms through team collaboration to support learning (Davidson, 1994), and to encourage positive peer interaction to motivate learning and to help each other (Johnson & Johnson, 1994).

Cooperative Learning

Over the past decade, there have been many research studies on the development of practical application of cooperative learning methods, in which students work in small, mixed-ability groups to master academic objectives. Results of these studies have indicated that when students were given an opportunity to work together and were rewarded based on the learning of all group members, they learned significantly more than students who

did not work cooperatively (Slavin, 1983, 1990; Sharon, 1980). There is also further evidence that cooperative learning is an effective instructional method for integrating students when compared to individual learning (Johnson & Johnson, 1989; Slavin, 1990).

Among the cooperative learning approaches, Team-assisted Individualization (TAI) has been used in elementary school math curricula. Most commonly, students will be placed in teams of 4 to 5 members with high- medium-, and low-ability. They work independently at their own levels and do their own assignments. Then they meet in teams, where they exchange papers, check each other's math accuracy, help each other, then take a check-out quiz. At the completion of the unit, students take a final test. Teams receive recognition based on the average number of units, i.e. the average number of problems completed and the accuracy of all team members. In addition to working with the teams, the teacher's role in TAI is to introduce major concepts using direct instruction prior to students working on their individualized units. Slavin, Madden, and Leavey (1984) compared TAI with individualized instruction (II) and a traditional method of teaching math in 18 mainstreamed classes from grade 3 to 5 in elementary schools. TAI was found to increase student math achievement: student test scores gained twice as many grade equivalents as those in the control classes with the traditional group teaching. In particular, TAI had strong effects on the social acceptance of mainstreamed students, on the development of

friendships, on students' attitudes toward math, and on teachers' reporting less problem behaviors in class (Slavin et al, 1984).

In TAI, students enter an individualized sequence, then proceed at their own rate. Team members work on different units based on their individual progress levels. Thus, all students have equal opportunities for success because all have been placed according to their level of prior knowledge (Slavin, 1990). This method has been regarded as an appropriate method for grouping students with different academic levels and ability, as well as teaching math to elementary school students in grade 3 to 6 (Slavin, 1990). Also, this cooperative learning method has shown significant improvement in social relationships between integrated students with disabilities and their classmates without disabilities. (Cooper, et al, 1980). Thus, cooperative learning benefits not only students with disabilities, but is also related to positive outcomes for all students in terms of academic achievement and social relationships (Slavin, 1990).

Cooperative Learning for Students with Disabilities

Children who have been placed in special education classrooms generally have skill levels below their peers in general education. Therefore, if the goal of special education is to prepare those children to re-enter general education classrooms, it is not sufficient just to keep their progress commensurate with the time spent in school (Putnam, 1992). Academic and social progress must be accelerated.

Educators have searched for ways to facilitate the progress

of the integration of students with disabilities. Cooperative learning offers an alternative approach to the integration of students by engaging students of various ability levels in shared instructional activities and learning experiences in the same class (Johnson, Johnson, & Holubec, 1986). Thus, students with special needs will not remain isolated in their special education classroom. Many research studies focused on cooperative learning for students with disabilities have indicated that cooperative learning (versus individualistic and competitive learning) increased the academic achievement and social acceptance of students with disabilities (e.g. Madden & Slavin, 1983; Johnson, 1983; Johnson & Johnson, 1989; Slavin, 1990).

Madden and Slavin (1983) reported that students with disabilities who were integrated gained more in cooperative learning classes than in classes with traditional whole-class instruction on the achievement test. Those students were named more often as friends and were rejected less often, and had less behavior problems than students with disabilities placed in traditional classes.

Johnson (1983) examined a group of 59, 4th graders, 12 of whom were learning disabled. All students were randomly assigned in one of three conditions: individualistic, competitive and cooperative learning. The results showed that students with learning disabilities received more verbal comments and were more physically closer during free time to their classmates during the cooperative condition. The students without disabilities were

better able to take the social perspective of their classmates with disabilities in the cooperative condition those in the competitive condition. These results also indicated that when cooperative learning was used to integrate special students into regular education classes, students with disabilities would not be isolated but would build social relationships with their nondisabled classmates, and their social acceptance and perspective-taking abilities would be increased (Johnson, 1983). Cooperative learning experience appears to be clearly associated with more positive interpersonal attraction between students with and without disabilities when compared to competitive or individualistic activities (Johnson & Johnson, 1989).

Despite what appears to be a solid body of evidence supporting the benefits of cooperative learning, some researchers have criticized the methodologies employed in the studies. One such concern is the short time of investigations from 3 to 6 weeks (Slavin, 1990). Such brief experiments may not address the effects of cooperative learning situations on the more lasting relationships among students, which are likely to fluctuate over time. In addition, Lloyd, Crowley, Kohler, and Strain (1988) indicated that research evidence on the effects of cooperative learning in reducing rejection of students with disabilities is substantial. However, questions remain about the method's effects on academic achievement. They argued and called for further research to focus on the academic achievement of students with and without disabilities as a function of cooperative learning.

Computer-assisted Cooperative Learning

A most recent instructional technology, computer-assisted instruction (CAI), has been identified as one of the more promising ways of adapting instruction to individual differences (Corno & Snow, 1986). CAI usually allows for individual differences in ability, rate of learning, and other related variables. Often the presentation of problems is tailored according to the students' answers and immediate feedback for each response is supplied. This has been seen as having potential to be used in integrated classes as a strategy to meet individual needs while enhancing on-task social interactions for a heterogenous group of students (e.g. Johnson & Johnson, 1986; Hooper, 1990)

A review of research on cooperative learning with CAI showed that pairs or small groups often show better learning outcomes than individuals (Light & Blaye, 1990). The advantages for students working in cooperative learning groups have been found with drill and practice software. In the study by Light and Blaye (1990), 6th grade students were assigned to either cooperative learning group to work with their partners or team members or worked alone on arithmetic drill and practice CAI programs. The results showed that students who had worked in cooperative learning groups achieved significantly better results than those who had worked alone (Light & Blaye, 1990). Research in cooperative learning methods applied to computer assisted instruction activities indicate that computers may be used to

further instructional goals that require group work. In a study by Johnson and Johnson (1986), 8th graders worked on a computer geography simulation and were compared across cooperative, individual and competitive conditions of instruction. The results showed that the students within the cooperative learning condition produced higher levels of achievement than those in the other two conditions. This evidence indicated positive effects when cooperative learning was added with computer-assisted curriculum activities. Thus, the combination of cooperative learning and computer-assisted instruction has been shown to be an effective way to implement in a variety of educational settings. However, little research has examined integrated classrooms to compare the relative effectiveness of computer-assisted cooperative to traditional whole-class learning, and to individual learning in promoting achievement, social interaction among students, positive attitudes toward the subject areas and students with disabilities, and relationships among students within groups. There is a need to examine this practice in integrated classrooms with students with and without disabilities. Issues specific to each of these components, i.e. cooperative learning and computer-assisted instruction, as well as their effects need to be examined. The present research project employed a TAI approach during math curriculum activities. The study was conducted in integrated classrooms with regular education students and students with learning disabilities. However, instead of cooperative learning only with

pencil and worksheets, this study implemented cooperative learning with computer-assisted math activities. And, instead of nondisabled students as samples as in previous studies (e.g. Johnson & Johnson, 1986; Mevarech, Stern, & Levita, 1987; Hooper, 1992), this research project had heterogeneous groups with students with and without disabilities who are integrated in general education classrooms. To avoid the failure to find statistically significant achievement effects due to the short duration of study (e.g. Slavin, Madden, & Leavey, 1984), this research project lasted for two years on two studies and partially followed Slavin's procedures of the TAI approach (Slavin, 1984, 1990).

RESEARCH REPORT

Study One: An investigation of computer-assisted cooperative learning comparing with whole-class instruction on math teaching in integrated classrooms

The purpose of this study was to investigate the outcomes of cooperative and whole-class learning within computer-assisted learning environment in mathematics for students with and without disabilities in integrated classrooms. The following 4 research questions were proposed:

1. Are there any differences in math achievement of students with and without disabilities under the condition of cooperative learning or whole-class instruction within a computer-assisted learning environment?
2. Are there any differences in attitudes towards math learning by students with and without disabilities under the condition of cooperative learning or whole-class instruction within a computer-assisted learning environment?
3. Are there any differences in social relationships among students with and without disabilities under the condition of cooperative learning or whole-class instruction within a computer-assisted learning environment?
4. Do the students with learning disabilities like to be included in the regular education classroom with their age appropriate peers to learn math together?

Research Method and Procedure

Participating Students

A total of 118 3rd grade students, among whom 25 were classified as learning disabled with IEPs in mathematics participated in the study. They attended three elementary schools located in suburban and urban areas in a northeast state of the United States (one in a suburban area and the other two in an urban area). 40% of these students were African American, 35% Caucasian, and 25% were Hispanic and others. The students with learning disabilities had been receiving math instruction from a special education teacher in a special education classroom of their school before they were included in the third grade general education class. Their average math level was at the second grade.

Equal numbers of students within the grade level in each school were randomly assigned to cooperative learning and whole-class learning groups, as well as the students with learning disabilities. To assess equivalence between the two groups, the math subtests of Primary level 3 (Form J) of Stanford Achievement Test (SAT) (1991) were administered to all the students. The test scores attained by students in each of the groups were evaluated using an analysis of variance (ANOVA) to determine if the were significantly different. The analysis yielded a $p > .05$, indicating no significant difference between the two groups of samples.

Participating Teachers

Six teachers who taught the 3rd grade classes and three special education teachers who assisted students integrated in

the regular classrooms in the target schools participated in the study. The six general education teachers were randomly assigned to a cooperative learning or whole-class learning group. Thus, there was one pair of general education teachers and one special education teacher in each school (a total of 9 teachers in 3 schools) to teach classes. To avoid the teacher effects (different teaching experience and personal characteristics), the 3 teachers in each school organized a team to shift teaching both cooperative learning and whole-class learning groups.

Research Design

The study employed a pre-post test control group design. Teachers in the three participating schools were assigned to cooperative learning or whole-class learning. Thus, in each school, there was one cooperative learning group and one whole-class learning group. The experiment was conducted for a whole spring semester in the regular classrooms and the computer labs in each school during regular math instruction sessions.

Instructional Materials

Based on the third grade math curriculum, the following instructional materials were used in the study:

Computer software

Three commercially produced computer software packages were used. Those packages cover math computation and application at the third grade level. Mathkeys (MECC, 1994), designed to be integrated with the Houghton Mifflin Mathematics textbook (1989), was the major program used during the math instruction.

Instructional sheet

An instructional sheet was given to each student during the instruction. The instructional sheet included an explanation of the skills to be mastered, the steps to be followed while working at the computer, and the procedures to be followed during the problem solving (See Figure 1).

Worksheet

Each worksheet included 10 mathematics problems that resembled the problem included in each computer practice session and in the textbook. The worksheets were used by students during daily practice sessions (See Figure 2).

Quiz

A quiz contained 10 question on what students had learned during the week. This quiz was given weekly for the both groups in the math class.

Teachers' Cooperative Team Work

To implement the cooperative learning approach in the classroom, the general and special education teachers decided to work together to plan and facilitate an inclusionary cooperative learning program involving team teaching. Planning was scheduled twice a week to develop lessons plans and to produce the Instructional Sheets, worksheets, and quizzes. They also discussed management issues and teaching techniques. The special education teacher discussed the individual student's IEP goals and objectives with the general education teacher. The general education teacher designed the schedules, teaching techniques,

and individual assignments with input from the special education teacher. Based on the team planning, the teachers developed the instruction sheet and worksheet weekly. As a result of their plan, the general education teacher was responsible for the overall instruction and class management while the special education teacher gave individual support to both special and general education students. They also took an equal responsibility to grade student worksheets, quizzes, and provided one another with feedback on their instructional skills. During the entire semester, the teachers planned and worked together as a team, and shift weekly to teach both cooperative and whole-class learning groups.

Treatment

The treatment was conducted in the regular classroom when the students had their regular math class for 30 minutes, then 20 minutes in the computer lab for the rest of the class during a whole semester (approximately 20 weeks), 4 days a week. On the fifth day, a quiz was given to all the students based on what they learned during the week.

Cooperative learning procedure

The computer-assisted cooperative learning was implemented through a four-step process. The steps included:

Step 1: Introducing cooperative learning

Initially, the teacher introduced how to build team cooperation to the whole class. Students were then grouped into teams of 4. Each team consisted of students of varying levels of

achievement, a mix of genders, as well as students with disabilities. Within each team the students were paired by twos and these pairs were re-formed weekly. The teams were re-grouped monthly. Within each team one student was selected to be the team leader, and within each pair, one student was selected to become the manager. Team members were seated as a group, so that the team could work at a computer in pairs and complete the assignment independently. After introducing the concept of cooperation, the teacher grouped students into teams to play a game, so that students could understand their team's function and be familiar with partners. Then, the teacher introduced the class to the major concepts, math problem solving procedures and related computer program. Each session consisted of an instruction sheet and a worksheet for class practice.

Step 2: Working at Computer with a partner

After the teacher's instruction, the class went to the computer lab. In the lab, each pair of students was assigned to one computer. Students were required to read the instructional sheet, and discuss instructions with their partners. Then two students worked at one computer to complete the section of the related computer program. Each student was required to solve five problems of the worksheet in the computer section. The partner checked the answers. If the answer was correct, the student would record it in the worksheet. If the answer was wrong, the student tried to solve the problem again with the partner's help.

Subsequently, the previous partner continued to solve the next problem, and the first student served as a partner. Students took turns working at the computer to complete their worksheet. When students within a pair got five of the problems correct, their partners would sign the sheet to indicate that they were certified by the team to complete that day's work.

Step 3: Working in a Team

When the pairs within a team completed the worksheet, the team leader would get the members together to check the answers. If the members had a different answer to a problem, the team would work together or discuss the procedures to determine the correct answer. If someone was having difficulty, other members would offer help. If questions remained, the team would ask for the teacher's help. Then, the team leader collected all the members' worksheets to keep in the team's folder for the teacher.

Step 4: Competing with other Teams

After completing the session, students took a quiz. Special education students took a quiz at their appropriate level. The team leader scored the quiz using an answer sheet produced by the teacher. The teacher checked the scores and computed a team's scores based on the average score of the quiz gained by each team member. At the end of the week, teams would be selected as "Super Team", "Great Team", or "Good Team" based on their scores, and received a team certificate. These certificates were posted on the class bulletin board to show each team's performance.

In the following week, the teacher would provide 10 minutes

instruction daily with small groups of students who were at about the same level of math and check students' understanding of the main concepts and procedures to solve problems in the specific session. Students would continue to work with their pairs, and teams. During the pair and team working period, both general and special education teachers served as a facilitator to provide assistance with questions about the session when students needed a help. The same cycle of teaching, working in pairs at computer, discussing in teams, taking an individual quiz was conducted during the whole semester.

Whole-class learning procedure

The teacher provided whole-class instruction on major concepts and procedures to solve problems in the specific unit of math class, then delivered the instruction sheet and worksheet to the students. In the lab, the teacher demonstrated the computer program to the whole class, and assigned students to work at computer individually. Students were required to complete the worksheet daily and a quiz weekly. The teacher scored the sheets and quizzes, and responded to students' questions. Except for the different procedures, the time allotment of the class and the curriculum materials used in class were the same as those used with the cooperative learning group.

Measurement

1. Math achievement. Students' math achievement was measured by Stanford Achievement Test (SAT): Mathematics Test (1991). This test includes concepts, computation, and application which was

administrated in group as a pre and post test.

2. Learning attitude. Students' learning attitude toward math was assessed by a 20 item questionnaire adapted from Mevarech and Rich's study (1985). The scale used an indirect technique to assess student feelings toward math, their effort in learning, and their anxiety toward math assignments and tests. The scores on each item range from 1-4 with high scores presenting high level of attitude, while low scores presenting low level of anxiety. The survey items were summarized into 7 factors based on a factor analysis: preference (liking of math), self-confidence, effort, accomplishment (4 positive factors) and anxiety, avoidance, disliking of math (3 negative factors). The scale was given to 43, 3rd and 4th graders in the same school district in order to examine test reliability. A test-retest interrelated coefficient of .67 was obtained on preference, .64 on self-confidence, .75 on anxiety, .50 on effort, .68 on avoidance, .61 on accomplishment, and -.37 on disliking of math. Those data indicate that the test is a reliable measure and acceptable for a teacher-made test with high and moderate correlation between the test and retest. This test was also provided to participating students as a pre and post test (See Figure 3).

3. Social acceptance. The Acceptance Scale (Voeltz, 1980) was used to assess regular students' attitude toward children with disabilities. The Acceptance Scale consists of 27 sentences relating varied positive and negative statements about individual differences and children with disabilities. A three-point score

(agree, disagree and undecided) is used. The reliability of the scale has been tested in both test-retest (with a stability coefficient of .68) and split-half (coefficient of .82) procedures (Voeltz, 1980, 1982). This attitude survey was administrated as a pre and post test, too.

4. Special education students' attitude. After the implementation of the treatment, an interview was held for special education students individually. Each interview lasted about 10 minutes based on a protocol with 8 questions (See Figure 4). A tape recorder was used throughout the interview. Descriptions of those students' attitude and feelings toward their peers and class have been summarized and stated in the result session of this report.

Procedural Reliability of Implementation

Since the study included 6 classes in 3 schools, it was important to keep instructional time allotments equal. Three methods were used to ensure the reliability of implementation of the instruction. First, teacher training was provided prior to the start of the study. The training contained 4 components: an on-site meeting with teachers presenting research theories and instructional procedures, a description of the computer program and computer-assisted instruction, methods to promote regular and special education teachers' team work, and in-class observation of the teacher's instruction. As a result, in each school, two regular and one special education teachers worked together to develop lesson plans, the instructional sheet, and a weekly quiz. Second, an in-class observation was conducted daily

in each class. Teachers' behaviors were observed and time of instruction was recorded. Two graduate students from Rowan College and three parents in the community were hired to be observers. They were trained to use the observation checklists (See Figure 5) developed by the Principal Investigator following procedures suggested by Borg and Gall (1996). The observation information was reported to the Principal Investigator by the observers and discussed with the teachers weekly. Meanwhile, an on-site meeting was held monthly with teachers at each school to discuss the project implementation and to solve problems.

Interrater Agreement

Two Rowan College graduate students graded the math achievement test and two survey tests. The raters were expected to obtain 98% agreement. If the agreement was lower than 98%, a third grader would have also graded the test. Three parents conducted the interview with each special education student individually. A cassette recorder was used to record the interview. Two people listened to the tape and filled in the responses in a copy of the interview protocol for each interviewee. Agreement between the two testers on the tape was calculated to reach 95% agreement.

RESEARCH RESULTS

The math achievement test and learning attitude survey were administrated to the students in both cooperative and whole-class learning group before (pretest) and after (posttest) the 20-week instructional period.

Math Achievement

Math achievement prior to instruction was measured using the Stanford Achievement Test: Mathematics Test (1991). The mean raw score of the SAT math test was 53.43 and the mean scaled score was 570 (grade level: 3.2) for regular education students; the mean raw score was 33.15 and the mean scaled score was 540 (grade level: 2.4) for special education students in the cooperative learning group. The mean raw score of the SAT math test was 57.42 and the mean scaled score was 575 (grade level: 3.4) for regular education students; the mean raw score was 33.25 and the mean scaled score was 540 (grade level: 2.4) for special education students in the whole-class learning group. An analysis of Variance (ANOVA) calculated to compare the scores attained by the two groups yielded $F(1, 116) = .61$, $P = .44$ ($p > .05$). The data indicated no significant differences between the two groups on the pretest that ensure equivalence between the two groups at the beginning of the study.

Immediately after the instruction the SAT was administered. The mean raw score of the SAT math test was 77.76 and the mean scaled score was 632 for regular education students; the mean raw score was 55 and the mean scaled score was 601 for special

education students in the cooperative learning group. The mean raw score of the SAT math test was 66.62 and the mean scaled score was 616 for regular education students; the mean raw score was 47 and the mean scaled score was 591 for special education students in the whole-class learning group. The pretest, posttest scores of math achievement were presented in Table 1.

Table 1:
Means and standard Deviations of Math Achievement Pre and Post Test

	General Ed				Special Ed			
Group	Number	Pretest		Posttest	Number	Pretest		Posttest
		Mean	SD	Mean SD		Mean	SD	Mean SD
Coop.	46	53.43	(24.2)	77.76(26.3)	13	33.15	(9.4)	55(19.7)
Whole	47	57.42	(25.6)	66.62(24.1)	12	33.25	(13.1)	47(26.5)

The differences were statistically analyzed using 2 x 2 analysis of variance with condition (cooperative vs. whole-class) serving as a between subject factor, and testing time (pre, post) serving as a within subject factor to analyze the data. Table 2 presents the analysis.

Table 2:

Analysis of Variance on Math Achievement Pre and Post Test

Source of Variation	SS	df	MS	F	P
Main Effects	17641.83	2	8820.92	13.41	.00
Group	624.81	1	624.81	.95	.331
Time	17017.02	1	17017.02	25.86	.00
2-way Interaction Group Time	2725.44	1	2725.44	4.14	.043

Results showed statistically significant main effect from

pretest to posttest scores, and a significant interaction between time of testing and condition of instruction, F = 4.14, P =.043, (P < .05).

A post hoc oneway ANOVA analysis was used to determine which scores differed significantly between groups. The analysis on the post test scores of each group yielded a significant difference in favor of the cooperative learning group, F(1,116) = 4.23, p = .042 (p < .05).

Table 3 reports the analysis.

Table 3

Analysis of Variance on Math Achievement Post Test

Source	df	SS	MS	F	P
Between Group	1	2980.08	2980.08	4.23	.042
Within Group	116	81785.69	705.05		

Learning Attitude

Learning attitude was measured by a survey which consisted of 20 sentences, underneath each sentence there were 4 scores ranging from 1 to 4 to represent strong agreement as the score 4, agreement as the score 3, disagreement as the score 2, and strong disagreement as the score 1. Students were asked to circle one score when their teachers read each sentence. The 20 statements were summarized into 7 factors based on the results of a factor analysis (see Table 4). Among the 7 factors: preference (liking of math) had a maximum score of 12, effort had a maximum score of 8, accomplishment had a maximum score of 12, and self-confidence

had a maximum score of 8. These 4 factors indicate that high scores reflect positive attitudes, while low scores reflect the negative attitudes. The remaining three factors: disliking of math (maximum score of 12), anxiety (maximum score of 16), and avoidance (maximum score of 8), indicate negative attitudes, i.e. low scores reflect positive attitudes, while high scores reflect positive attitudes. The pretest and posttest are presented in Table 5.

Table 4

Rotated Factor Matrix Variables with Loading over .5

Factor/Attitude Scale Item	Factor-pattern coefficients 1	2	3	4	5	6	7
Liking of Math							
It's fun to solve math problems.	.71						
Working with numbers is fun.	.55						
If I find a math problem hard, I would work harder.	.51						
Effort							
I sometimes do more math than what is required.				.80			
I like to do extra work in math when I have time .				.70			
Accomplishment							
I like to do math problems in groups.						.65	
Math is more like a game than hard work.						.58	
I always complete my math assignments.						.60	
Self-confidence							
I feel at ease when doing math problems.							.81
I always try to get good grades in math.							.50
Anxiety							
Doing math problem upset me.		.64					
Math class gives me stress.		.58					
I am afraid of not doing well in math.		.70					
I fell upset about my math grades.		.63					
Avoidance							
When doing math I skip the hard problems.					.54		
I worry a lot about how I am doing in math.					.78		
Disliking of Math							
I don't like math very much.			.83				
Doing math problem is boring.			.74				
Math is not my favorite class.			.51				

Table 5
Means and standard Deviations of Learning Attitude Pre and Post Test

Group	Factors	Regular Ed				Special Ed			
		Pre		Post		Pre		Post	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD
Coop	Liking of Math	9.98	2.26	10.04	2.21	8.77	3.04	11.38	1.04
	Effort	5.58	2.13	5.43	1.96	4.38	2.29	5.85	2.27
	Accomplishment	9.39	2.03	9.36	2.01	9.38	2.33	10.08	2.46
	Self-confidence	6.97	1.33	6.73	1.73	6.38	1.44	7.15	1.44
	Anxiety	8.46	3.85	8.60	3.56	7.92	2.92	10.15	3.60
	Avoidance	5.81	1.83	5.72	1.76	5.38	2.10	5.84	1.57
	Disliking of Math	6.63	2.95	5.38	2.11	7.77	2.13	6.54	2.53
Whole	Liking of Math	9.77	2.46	9.93	2.17	7.00	3.30	7.25	3.72
	Effort	5.11	2.09	5.11	2.18	4.08	1.67	4.00	2.33
	Accomplishment	9.04	2.43	9.24	2.37	7.67	3.58	6.92	2.94
	Self-confidence	6.93	1.34	6.77	1.38	5.50	2.32	5.17	1.99
	Anxiety	8.91	3.35	9.16	3.21	9.17	2.08	10.5	3.21
	Avoidance	5.64	2.07	5.84	2.01	4.92	2.06	4.83	2.25
	Disliking of Math	7.23	3.21	6.64	2.85	7.25	2.86	8.08	3.03

A 2 x 2 analysis of variance with condition (Cooperative vs whole-class) serving as a between subject factor, and testing time (pre, post) serving as a within subject factor was used to analyze the data.

Although the survey scores of the cooperative group on preference, effort, accomplishment, and self-confidence are higher, and scores on disliking of math are lower than those of the whole-class group, there was no interaction between instructional condition and testing time on the analysis of variance.

Social Acceptance

Regular students' attitude toward special education students was measured by using the Acceptance Scale (Voeltz, 1980) which consisted of 27 sentences relating varied positive and negative statement about individual difference and children with disabilities. A three-point score (agree, disagree, and undecided) is utilized. According to Voeltz (1980), 4 factors, social contact willingness, actual contact with disabled children; mild deviance consequation, and avoidance are included. Factor 1 and 2 have positive scores indicating acceptance, while Factor 3 and 4 contain negative items so that low scores indicate acceptance. Table 6 presents the pre and post test scores.

Table 6
Mean and standard Deviations of Social Acceptance Pre and Post Test

Group	Number		Pre		Post	
		Factors	Mean	SD	Mean	SD
Coop	48	Willingness	18.10	5.58	19.40	3.34
		Actual contact	4.76	2.95	6.11	3.31
		Mild deviance	4.57	1.90	4.09	2.44
		Avoidance	9.38	2.96	7.98	3.23
Whole	45	Willingness	16.91	4.49	17.20	4.65
		Actual contact	4.91	3.07	7.13	3.81
		Mild deviance	3.49	2.26	4.27	2.58
		Avoidance	9.38	2.91	9.16	3.21

A 2 x 2 analysis of variance with condition (Cooperative vs whole-class) serving as a between subject factor, and testing time (pre, post) serving as a within subject factor was used to analyze the data.

Although the survey scores of the cooperative group on social contact willingness are higher, and scores on mild deviance and avoidance of social acceptance are lower than those of the whole-class group, there was no interaction between instructional condition and testing time on the analysis of variance.

Opinions of Special Education Students

An interview was conducted with each special education student after the implementation of the project. During the interview, the interviewer asked each interviewee questions in the protocol, also appropriate probes and follow-up questions

were used to solicit a full-range of responses and to assure that all students had an opportunity to state their point of view. A cassette recorder was used to record the interview. Subsequently, two people listened to the tape and filled in the interviewee's opinions to the questions in the protocol. The interview data was summarized based on the suggestions of Lincoln and Guba (1985).

Cooperative Learning Group

The students with learning disabilities in the cooperative learning group across all three schools consistently indicated their preference for being in the regular classroom with their general education peers. All the student responses were positive toward their inclusion in general education classes. Some examples of their responses included statements such as,"..like the class; like to be in the class." Several students indicated that they also liked their special education class and their special education teacher and teacher assistants, so their answers were 'enjoy going back and forth.' When asking the difference between the math class and their previous special education class, most students said,'we have more kids, more activities, more friends, but hard work, more tests.' One said, 'I learn 2nd grade math in Mrs. xx's class (special education class), but I have to learn 3rd grade math here. It's hard.' In response to the question about whether they liked to work in teams with their partners, all the students had positive comments such as 'like to work in the team; help me when I am stuck on a problem; I learn more in groups; group members help me work out

problems; without teams I am bored; we work together, do things together in different ways.' When asking 'who is your friend in the class?', every student mentioned at least one general education student's name besides their friends in their previous special education classrooms.

Whole-class group

In general, student responses were negative toward their inclusion in the regular classrooms. No one liked to stay in the class, though some students indicated that they liked to learn math with a computer, and they were expected to learn more in the regular class than they did in their special education class. Representative comments on the class were 'too many kids, lots of noise; work is too hard; math is difficult.' One student mentioned that he would rather stay in special education class all day. When asking why they did not like to be in the regular class, most students said that the worksheets were too hard and they did not get help as what they had in the special education class. One student mentioned that sometimes when he could not figure out the problem he would be called 'stupid'. Another student said, 'Ms. xx's kids are smart, but being in there with them is not so happy sometimes. Sometimes they call me names.' In response to the question 'Who is your friend in the class?' most students mentioned their former classmates who had been with them in the special education class and were included together in the class. Only two students mentioned their general education classmates who were sitting next to them when working in the

computer lab.

Study Two: An investigation of computer-assisted cooperative learning comparing with individual learning in math in integrated classrooms

The purpose of this study was to investigate the outcomes of cooperative and individual learning within computer-assisted learning environments in mathematics for students with and without disabilities in integrated classrooms. The following 4 research questions were proposed:

1. Are there any differences in math achievement of students with and without disabilities under the condition of cooperative learning versus individual learning within a computer-assisted learning environment?
2. Are there any differences in attitudes towards math learning by students with and without disabilities under the condition of cooperative or individual learning within a computer-assisted learning environment?
3. Are there any differences in social relationships among students with and without disabilities under the condition of cooperative or individual learning within a computer-assisted learning environment?
4. Do the students with learning disabilities like to be included in the regular education classroom with their age appropriate peers to learn math together?

Research Method and Procedure

Participating Students

A total of 93, 4th grade students, among whom 16 were classified as learning disabled with IEPs in mathematics participated in the study. They attended 2 elementary schools located in urban areas. 85% of these students were African American, and 15% were Caucasian, Hispanic and others. The students with learning disabilities had been receiving math instruction from a special education teacher in a special education classroom of their school before they were included in the fourth grade general education class. Their average math level was at the beginning of the third grade or end of the second grade.

Equal numbers of students within the grade level in each school were randomly assigned to cooperative and individual learning group, as well as the students with learning disabilities. To assess equivalence between the two groups, the math subtests of Intermediate 1 (Form J) of Stanford Achievement Test (SAT) (1991) were administered to all the students. The test scores attained by students in each of the groups were evaluated using an analysis of variance (ANOVA) to determine if they were significantly different. The analysis yielded a $p > .05$, indicating no significant difference between the two groups of samples.

Participating Teachers

Four teachers who taught the 4th grade classes and two special education teachers in the target schools participated in the study. The four general education teachers were randomly

assigned to a cooperative or individual learning group. Thus, there was one pair of general education teachers and one special education teacher in each school (a total of 6 teachers) to teach classes. To avoid the teacher effects (different teaching experience and personal characteristics), the 3 teachers in each school organized as a team to shift weekly to teach both cooperative and individual learning groups.

Research Design

The study employed a pre-post test control group design. Teachers in the two participating schools were assigned to cooperative or individual learning. Thus, in each school, there was one cooperative learning group and one individual learning group. The experiment was conducted for a whole spring semester in the regular classrooms and the computer labs in each school during regular math instruction sessions.

Instruction Materials

The same two computer software packages that were described in Study One were used for math learning. Considering the age difference from the third graders in the first year's study, one package was changed to meet the age level. Still, Mathkeys was the main package used in the study. The class worksheets were developed by the teachers based on their math curriculum with the same format as those in the first year's study.

Treatment

Cooperative learning procedures were the same as those in the study one.

The individual learning group kept the same time allotment as the cooperative learning group. The teacher used small group teaching to introduce the major concepts and problem solving procedures to students. However, since the urban schools do not have a teacher assistant in class, the small group instruction was hard for them, so the teacher had whole-class teaching sometimes during the math instruction. Then, students were required to work individually at the computer, not in pairs and teams. They checked their own answers of worksheets, and scores were graded by their teachers.

Settings

The math teaching and learning were conducted 30 minutes in class and 20 minutes in computer lab following the math curriculum. It lasted a whole spring semester about 20 weeks.

Measurement

The format of the measurement was same as that in the study one, which included math achievement, learning attitude and social acceptance of regular students and the attitude of special education students towards their peers. The data analysis methodologies were the same as those used in the study one.

RESEARCH RESULTS

The math achievement test and learning attitude survey were administrated to the students in both the cooperative and individual learning group before (pretest) and after (posttest) the 20-week instructional period.

Math Achievement

Math achievement was measured using the Stanford Achievement Test: Mathematics Test (1991). The pretest mean raw score of SAT math test was 40.25 and the mean scaled score was 581 (grade level:3.4) for regular education students in the cooperative learning group; the mean raw score was 31 and the mean scaled score was 566 (grade level: 3.0) for special education students in the cooperative learning group; the mean raw score was 37.97 and the mean scaled score was 578 (grade level:3.4) for regular education students in the individual learning group; the mean raw score was 33.85 and the scaled score was 570, (grade level: 3.2) for special education students in the individual learning group. An analysis of Variance (ANOVA) calculated to compare the scores attained by the two groups yielded F (1, 91)= .02, P = .89. (P > .05) The data indicated no significant differences between the two groups on the pretest that ensure equivalence between the two groups at the beginning of the study.

The pretest and posttest scores for math achievement were presented in Table 7.

Table 7:
Means and standard Deviations of Math Achievement Pre and Post Test

	General Ed				Special Ed			
Group	Number	Pretest		Posttest	Number	Pretest		Posttest
		Mean	SD	Mean SD		Mean	SD	Mean SD
Coop.	43	40.25	(12.5)	70.09 (16.03)	6	31	(6.05)	40 (10.47)
Indiv.	38	37.97	(9.64)	74.91 (28.13)	6	33.85	(19.31)	63 (25.12)

A 2 x 2 analysis of variance with condition (Cooperative vs Individual) serving as a between subject factor, and testing time (pre, post) serving as a within subject factor was used to analyze the data. There was no interaction between instructional condition and testing time on the analysis of variance.

Learning Attitudes

Learning attitudes were measured by the same survey used in the study one. The pretest and posttest scores are presented in Table 8.

Table 8:

Means and standard Deviations of Learning Attitude Pre and Post Test

Group	Factors	Regular Ed				Special Ed			
		Pre		Post		Pre		Post	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD
Coop	Liking of Math	10.09	2.47	10.12	2.57	8.83	3.54	8.83	3.18
	Effort	6.07	2.15	5.51	2.09	5.67	2.58	5.83	2.23
	Accomplishment	10.12	1.78	9.44	2.59	7.50	2.88	8.17	2.32
	Self-confidence	6.88	1.33	6.49	1.74	5.67	2.42	5.50	1.38
	Anxiety	9.51	2.98	9.19	3.59	11.16	2.78	8.0	3.4
	Avoidance	5.88	2.08	5.91	1.96	6.33	2.06	6.0	2.09
	Disliking of math	5.72	2.89	5.86	2.38	7.5	2.58	7.0	3.35
Whole	Liking of Math	10.14	1.89	9.70	2.46	10.57	1.13	11.50	.84
	Effort	5.43	1.76	5.59	1.86	5.57	1.39	6.67	1.51
	Accomplishment	8.54	1.94	9.32	2.25	9.57	2.15	10.33	1.6
	Self-confidence	6.65	1.40	6.14	1.84	6.71	.95	7.67	.52
	Anxiety	9.29	3.39	10.05	3.5	9.71	3.4	9.67	3.93
	Avoidance	5.95	1.84	5.57	1.92	5.86	1.07	5.67	2.07
	Disliking of math	6.49	2.74	6.24	2.59	5.57	1.99	5.67	2.07

A 2 x 2 analysis of variance with condition (Cooperative vs whole-class) serving as a between subject factor, and testing time (pre, post) serving as a within subject factor was used to

analyze the data. There was no interaction between instructional condition and testing time on the analysis of variance.

Social acceptance

The same scale as was used in the study one was used to examine the regular education students' attitude towards the special education students who were included in their classroom. Table 9 presents the pre and post test scores.

Table 9:

Mean and standard Deviations of Social Acceptance Pre and Post Test

Group	Number		Pre		Post	
		Factors	Mean	SD	Mean	SD
Coop	42	Willingness	19.90	3.45	19.46	5.28
		Actual contact	5.67	3.19	6.68	2.90
		Mild deviance	3.79	2.38	4.41	2.05
		Avoidance	8.07	3.71	6.46*	3.46
Whole	35	Willingness	15.35	5.14	15.39	5.46
		Actual contact	5.11	3.22	5.18	3.09
		Mild deviance	2.65	2.00	2.55	1.89
		Avoidance	7.49	2.88	6.45	3.16

* indicates significant difference (P<.05)

A 2 x 2 analysis of variance with condition (Cooperative vs whole-class) serving as a between subject factor, and testing time (pre, post) serving as a within subject factor was used to analyze the data. There was no significant difference on the three factors: willingness, actual contact and mild deviance between groups. However, there was a significant main effect from pre and post test scores on the factor: avoidance of social

acceptance, and a significant interaction between time of testing and condition of instruction, $F = 5.95$, $P = .02$, ($P < .05$). The general education students' scores for avoiding social acceptance of special education students decreased significantly from pre to post test.

Opinions of special education students

An interview was conducted with each special education student after the implementation of the project. The same interview protocol as described in the study one was used during the interview. The interview data was summarized as follows:

In general, students in both the cooperative learning and individual learning groups gave negative responses toward their inclusion in the regular classrooms: No one liked to stay in the class, though all the students indicated that they liked to learn math with a computer. The comments on the class were: 'work is hard; too many tests; lots of noise; the teacher is too loud.' All the students mentioned that they would like to stay in special education class with their special education teachers. In response to the question about their friends in the class, three students in the cooperative learning group mentioned several general education students' names while the rest indicated their friends in their special education classrooms.

DISCUSSION

Since the late 1980s, the term 'integration' used to describe how general and special education students were learning

together, has been replaced by 'inclusion'. Inclusion refers to the provision of appropriate educational services to all students in regular classes attended by nondisabled students of the same chronological age in their neighborhood school, including students with disabilities (Giangreco & Putnam, 1991). However, the concerns and arguments around the term 'inclusion' include: What appropriate instructional strategies, interventions, or methods can be implemented within such classes to serve both general and special education students effectively? Cooperative learning has been indicated as a possible strategy for successful inclusion (Davidson, 1994, Johnson & Johnson, 1994). Questions about how to effectively implement the cooperative learning strategy, and how it works for both general and special education students if computer-assisted instruction is introduced at the same time remain to be examined. The purpose of the current research was to examine the student achievement, learning attitudes, social relationship among students with and without disabilities in a computer-assisted cooperative learning environment in inclusive settings.

Student Achievement

Results of study one demonstrated that students in cooperative learning groups statistically outperformed students in whole-class traditional instruction groups. Although students in both cooperative and whole-class groups increased their math learning with computer assisted instruction, a significant difference was obtained on the post test between the two groups.

Moreover, a significant interaction between time of test (pre vs. post) and instructional group (cooperative vs. whole-class) showed that computer-assisted cooperative learning had a great effect on math learning for students with and without disabilities integrated in a general education class. This result along with other studies in previous years (King, 1989; Johnson & Johnson, 1985; Light & Blaye, 1990) supports the view that the cooperative learning strategy can enhance performance in a technology-assisted environment. Also, this result may address the concerns of teachers about the benefits gained by the average and high achieving students as they played the roles in cooperative learning groups. However, there was no significant difference found in student achievement between the cooperative learning and individual learning groups in study two. This may be the result of the age difference between the two studies since Study two was conducted in 4th grade classrooms, while Study one was conducted with 3rd graders. Also, the sample of students in study one was larger than that in study two which was less than desired by the experiment. A larger sample size would be suggested for 4th graders in future research.

Learning attitude

The current research found that computer-assisted cooperative learning has a positive influence on attitudes in a learning situation. The results showed that students in cooperative learning groups scored higher on preference, effort, accomplishment and self-confidence, and lower on disliking of the

subject area than students in the whole-class and individual learning groups respectively, though there was no significant difference between the groups. Especially for special education students, their attitude scores on preference of the subject area were higher than the score of their pretest. These findings are consistent with other studies indicating that cooperative learning has a strong influence on attitude and motivation in educational settings (Johnson, 1989, Slavin, 1990).

In computer-assisted cooperative learning activities, general and special education students were assigned to work in teams and given tasks to accomplish with the help of the computer. The rewards of team work were based on their task performance, collaboration and contribution of each team member. The shared goals and tasks gave students a chance to work together, help and encourage each other. The computer served as a tool to help students working at different levels. It seems that peer support within cooperative learning would enable special education students to overcome problems that they might not overcome if they were working by themselves. This also could be found in special education students' responses on the individual interviews. They liked to work in groups and get help when they had difficulty. It appears that their participation in group tasks are principal factors motivating their learning.

Social acceptance

Socially the impact of cooperative learning was positive for both general and special education students. The results of the

social acceptance scale showed that general education students' willingness to have social contact with students with disabilities was higher, and avoidance of social contact was lower than those in whole-class group, though there was no significant difference between the two groups. However, general education students in cooperative learning groups scored significantly lower on avoidance of contact than those in the individual learning condition ($p<.05$). Meanwhile, in study one, every special education student in cooperative learning group mentioned at least one general education student's name as his/her friend while no general education student's name was mentioned by the special education students in the whole-class and individual learning group. This may indicate that there were better peer relationships in cooperative learning situations, a finding that replicates that of previous research (e.g. Johnson & Johnson, 1989, Slavin, 1990). Perhaps, it is likely due to the cooperative learning process with diverse students working together to achieve their common goals. During the cooperative learning process, teams were changed over time so that the students could collaborate with a variety of students in the class leading to better peer relationships and an increase in students' friendships. As a result, this learning process produces a meaningful interaction among students with and without disabilities.

Special Education Students' attitudes toward Inclusion

The results of the interview data in study one showed that

special education students in the cooperative learning group liked to be in the regular class with their age appropriate general education peers. For example, when asking the difference between the math class and their previous special education class, most of them said, 'we have more kids, more activities, more friends, though hard work, more tests.' They also liked to work in teams with their partners. Most of them commented on their group, 'help me when I am stuck on a problem; group members help me work out problems; we work together, do things together.' In contrast, the responses of special education students in whole-class and individual learning groups were negative toward their inclusion in the regular classrooms. No one liked to stay in the regular class even though some of them indicated that they liked to work on the computer. This finding may imply that special education students would rather stay in the self-contained class if they are included in a regular class without support and help from their peers. Computer-assisted cooperative learning may supplement the teacher's instruction by giving students a chance to practice skills at a computer with their team members. This practice may create a way for students at different levels to work together toward their academic and social goals.

Conclusion

Cooperative learning is a useful strategy for effecting the inclusion of students with disabilities in general education classrooms since it can provide an integrated situation for

diverse students to work together (Sapon-Shevin, 1991). The computer serves as a teacher's aide -- an instructional tool, one that is always met with great excitement by students. In an inclusive classroom, computer-assisted cooperative learning may create a way to facilitate the inclusion of diverse students and assist teachers to meet the needs of students at different levels. The results of the current research may add valuable information to previous studies on cooperative learning. It also indicates that a structured cooperative learning strategy within a computer-assisted environment may affect performance, attitude and social relationships among students with and without disabilities. When learning situations are structured cooperatively, general and special education students can work together in pairs or teams. Students support and help each other to encourage themselves to accomplish their learning tasks. They learn to accept different views from their team members, understand and learn from each other. This learning experience may motivate students with and without disabilities in their academic achievement and social skill attainment in schools.

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DISSEMINATIONS

Eight types of dissemination activities both at regional and national level have been conducted as follows:

1. Computer-assisted cooperative learning strategy in inclusive classrooms was presented by the Project Investigator and participating teachers (both regular and special education) at the regional conference on inclusive education.

2. Research results of Study One were presented by the Project Investigator and one participating teacher at TAM conference, Austin, TX, January, 1996.

3. "Working together: Computer-assisted cooperative learning for math instruction", paper, co-authored by the Project Investigator and some participating teachers, has been submitted for publication consideration in Teaching Exceptional Children.

4. "Computer-assisted cooperative learning in an inclusive classroom", paper, co-authored by the Project Investigator and some participating teachers has been accepted by ERIC document publication.

5. "Two instructional models in inclusive classrooms", a poster session was presented at annual conference of CEC, Orlando, FL, April, 1996.

6. A final report of the project will be submitted to ERIC as well as the funding agency.

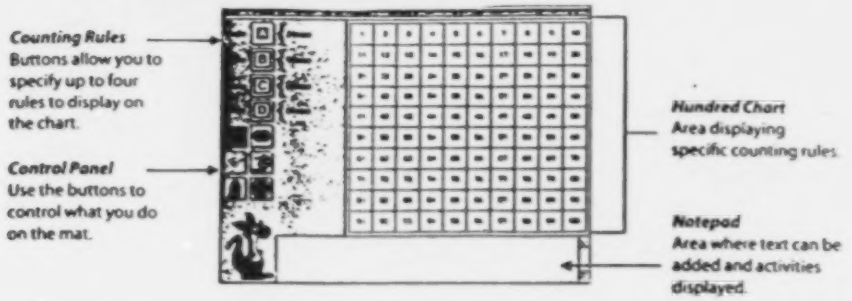
7. Research results of the project have been accepted for presentation at the annual conference of CEC, 1997.

8. Two research papers are in preparation and will be

submitted to related journals for publication consideration (Exceptional Children & Special Education Technology).

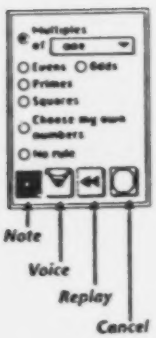
Figure 1

1. Place arrow on 100's chart (Click)
2. This screen will appear:


Counting Rules
Buttons allow you to specify up to four rules to display on the chart.
Control Panel
Use the buttons to control what you do on the mat.
Hundred Chart
Area displaying specific counting rules.
Notepad
Area where text can be added and activities displayed.

3 Place arrow on Rule A -(Click)

4 Place arrow on 'Choose my own numbers' (Click)



5. Decide which X table you need to practice with. (For example: 7x table)
6. Move arrow to 100's chart and as you say the X table to yourself move the arrow to the correct answer and click.
   (ex: 7x1=7) Place arrow on 7 (click)
   A black box will appear on number.
7. Go through the entire 7x table clicking each correct answer.
8. When you get to 7x12 = and have clicked your answer - Move arrow to OK - click
9. Move arrow to Rule B (click)
10. Move arrow to Mult. of one
    and click but keep button pressed
    so you can drag mouse down until (7) is in the dark box - (release mouse)
    - All mult. of 7 will now be high lighted in orange.
    Move arrow to 'ok' (click)

Black boxes you selected should be highlighted in orange.

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Figure 2

Name _____ Date _____ (7)

Math Check Up ✓

① $0.08 × 6

② $0.24 × 3

③ $0.73 × 3

④ 7 × 51 =

⑤ 4 × 23 =

⑥ 9 × 71 =

⑦ 16 × 6

⑧ 80 × 9

⑨ 62 × 3

⑩ There are 36 inches in <u>one</u> yard. How many inches are there in <u>three</u> yards? (Write a number sentence and solve.)

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Figure 3

Mathematics Attitude Survey Scale

Name:_____ **Teacher**_____ **School**_____

Directions: Please listen to your teacher. She will read a sentence to state some information.
If you strongly agree with the statement, circle the 4.
If you agree with the statement, circle the 3.
If you disagree with the statement, circle the 2.
If you strongly disagree with the statement, circle the 1.
Let's start.

1. It's fun to solve math problems.

   1 2 3 4

2. I like to do math problems in groups.

   1 2 3 4

3. I sometimes do more math than what is required.

   1 2 3 4

4. I don't like math very much.

   1 2 3 4

5. Working with number is fun.

   1 2 3 4

6. Doing math problems is boring.

   1 2 3 4

7. Math is more like a game than hard work.

   1 2 3 4

8. If I find a math problem hard, I would work harder.

   1 2 3 4

9. I always complete my math assignments.

   1 2 3 4

10. When doing math I skip the hard problems.

    1 2 3 4

11. I like to do extra work in math when I have time.

1 2 3 4

12. Math is not my favorite class.

1 2 3 4

13. I always try to get good grades in math.

1 2 3 4

14. Doing math problems upset me.

1 2 3 4

15. I worry a lot about how I am doing in math.

1 2 3 4

16. I feel nervous when taking a math exam.

1 2 3 4

17. Math class gives me stress.

1 2 3 4

18. I am afraid of not doing well in math.

1 2 3 4

19. I feel at ease when doing math problems.

1 2 3 4

20. I feel upset about my math grades.

1 2 3 4

Figure 4

Interview Protocol

1. Describe your former classroom.

Probe: a. Can you tell me something about your former classroom, students, teacher, group?

2. How does the math class differ?

Probe: a. What's the difference between the math class and the other classes? (students, teacher, group)

3. Describe students in the math class.

Probe: a. Can you tell me something about your classmates in the math class?
b. Are they from general education classrooms? Special Education classrooms?

4. Describe students in your team, or your pair.

Probe: a. Who is in your team?
b. Who is your partner?

5. How do your classmates, teammates, partners help you?

6. Who is your friends in the class, team? What do you do with your friends in class or out of class?

7. How do you think when you are working with students of general education (nondisabled peers)?

8. Describe benefits and short comings you think you get by being in this integrated classroom.

Probe: a. Do you think it is good to be in the integrated classroom? Why or Why not?
b. What are the benefits you think you get? What are the shortcomings?

Figure 3

Implementation Checklist A: Definitions

Time Allocated for Math: Record the time the teacher has planned to devote to for the math class.
Lesson Objectives: Tell what the topic of the lesson is (i.e. fraction, division, multiplication, etc.)
Students in Classroom: Count the number of students physically present in the classroom during the time of math instruction.

Teacher Behaviors:	1.	Review prior learning: Teacher summarizes previous day's materials, or briefly review prerequisites for today's lesson.
	2.	Specify the lesson objective: Teacher tells the students what they are about to do.
	3.	Introduce skills or process: Teacher prompts by questioning or instructs students the skills and process on board or transparency (for the whole class or for a group)
	4.	Demonstrate skills at computer: Teacher demonstrates the skills or process at computer (for the whole class or for a group).
	5.	Use examples: Giving examples by modeling how to solve the problem.
	6.	Organize groups: Teachers assign students into groups.
	7.	Explain worksheet: Teacher delivers the sheets and explains the worksheet to students.
	8.	Check for student understanding by asking questions: Teacher provides opportunities to respond in some form to make sure student understood.
	9.	Explains why an answer is correct or incorrect: statements like 'That's right because...', as well as 'That's incorrect because...'
	10.	Provide for practice: Teacher gives an assignment for students to do in class, or in groups; gives questions for all students to discuss or to respond.
Student Behaviors:	1.	Work in teams or pairs: Students sit in teams or pairs and work together.
	2.	Work at computer: Students work at computer in pairs or individually.
	3.	Team or pair discussion: Students discuss in pairs or teams about the skills or procedures.
	4.	Independent seatwork: Students practice individually at their seat.
	5.	Sheetwork: Students work on the sheets in pairs, in teams or individually.
	6.	Quiz: Students take a quiz.
	7.	Check answers: Students check answers of their sheets following the keys.
	8.	Response teacher's question: Answer teacher's questions.
	9.	Off task: Off seat, talk out, do something else without permission.
	10.	Interrupt the class: Any behaviors cause the class activity suspended or instruction suspended.

Implementation Checklist B

Observer: _____ Date: _____

Teacher: _____ School: _____

Observation Time: Beginning: _____ End: _____

Time Allocated for Math: _____

Lesson Objectives: _____

Students in Classroom: _____

Students in Teams: _____

Classroom Format: Whole-class _____ Individual _____ Team _____ Pairs_____

Teacher Behavior code: (+) observed (-) did not observe

1. Review Prior Learning: _____
2. Specify the Lesson Objective: _____
3. Introduce Skills & Process: _____
4. Demonstrate Skills at Computer: _____
5. Using Examples _____
6. Organize Groups _____
7. Explain Sheetwork _____
8. Check for Student Understanding by asking questions _____
9. Explaining why an answer is correct or incorrect _____
10. Provide practice _____

Percent of Behavior Occurrence: % (plus all the behaviors/10)

Student Behavior code (+) observed (-) did not observe

1. Work in teams or pairs_____ Time Allocated_____

2. Work at computer_____ Time Allocated_____

3. Team or pair discussion_____ Time Allocated_____

4. Independent Seatwork_____ Time Allocated_____

5. Sheetwork_____ Time Allocated_____

6. Quiz_____

7. Check answers_____ Time Allocated_____

8. Respond teacher's questions_____

--Number of student responses:_____

--Number of students respond to questions_____

--Number of students ask questions_____

--Number of questions asked by students_____

--Average time of latency between response and question_____

9. Off Task:_____

--Number of students off task_____ Examples_____

10. Interrupt class:_____

--Number of students interrupt class:_____

--Time of interruption:_____